

a series of long leases which gives the company at the lowest stage of the stream a daily flow of fully 15,000,000 gallons. From July, 1900, to July, 1901, the rainfall at Koloa was 72.69 inches, which was greatly exceeded at the higher mountain altitudes.

In connection with the mountain supply of water the company has erected, at a suitable point a "Heidier duplex" 5,000,000-gallon pumping system which raises the water from the natural streams in a single lift of 130 feet and discharges into reservoirs having a capacity equal to 15,000,000 gallons, from whence it is distributed by a system of pipe lines and ditches to the different cane fields.

About 20,000,000 gallons is the average daily supply of water at the present time from all sources, but this does not by any means represent the total available water, as by the erection of additional storage reservoirs the supply could be largely increased from the mountain sources. The company is now boring for water at Mahalepū and intends to erect another pumping plant for the purpose of irrigating a body of cane lying below the pumping system.

The method adopted to convey the cane from field to mill is a main railroad system ten miles in length, which is connected with portable held track some two miles in extent. The main line is supplied with 250 cane cars having an average capacity of 2 1/2 to 3 tons, which are hauled to the mill by two Baldwin and two German locomotives.

There are about 800 laborers upon the plantation, probably one-half of the work being performed by day labor and one-half by company men or profit-sharers. The average pay for unskilled labor is \$2.50 a month, with, besides, house room, fuel, water and medical attendance, the company maintaining its own hospital. During the grinding season of 1900 the total output of the mill was 5004 tons, while the season of 1901 just closed shows an increase of 1000 tons. For the 1903 crop there has been planted some 800 acres, and the estimated output of sugar for that season, which will come off 1600 acres, including lands of individual planters, will be in excess of the season of 1901 or 1902.

Up to the present time the average return of sugar from the entire area devoted to cane is about four tons of sugar to the acre, or a ton of sugar to eight tons of cane.

Upon the plantation have been erected two three-roller and one two-roller mills, the cane being fed direct to the mill without any special treatment. The mill is supplied with the Deming super-heating system, 5 open clarifiers, one 9 and one 12-ton vacuum pans, triple effect, thirteen Weston make and three Hepworth centrifugals and a sacking device, taking sugar direct from centrifugals, etc. The three mills are driven by two Corliss engines, steam being generated by the use of the bagasse, which is fed automatically to the furnaces. The company manufactures one grade of sugar, all the lower grade sugars and molasses being worked over into the No. 1 grade. The capacity of the mill is eighty tons in twenty-four hours, but as the mill is only operated during the daytime the output is about one-half of that amount.

The average mill extraction of the sucrose in cane is from 88 to 90 per cent, depending very largely of course upon the general conditions of the cane, etc.

Connected with the mill are the machine and carpenter shops, where the various appliances are driven by water power. Water for mill purposes is taken from the stream flowing by the mill.

As is the case in many of the mills in the islands, all cane is weighed before going through the mill. Connected with the mill is the laboratory, where all sugars manufactured are under complete chemical control.

Some two miles from the mill is the steamer landing, to which point all sugar is conveyed by rail, and thence shipped to Honolulu. Here has been erected a warehouse capable of holding 12,000 sacks of sugar.

Upon the lands of the company there are the following stocks of animals for working purposes and meat supply of the plantation: Working cattle, 300 head; beef cattle, 500 head; sheep, 600 head; mules, 80 head; horses, 150 head.

P. McLane is manager of the plantation and has been identified with the sugar industry in the Hawaiian Islands since 1882.

Following is the list of officers and directors:

Paul Isenberg, President.  
H. Isenberg, Vice President.  
H. A. Isenberg, Treasurer.  
T. W. Hobron, Secretary.  
W. G. Smith, Auditor.  
Hackfeld & Co., Agents, Honolulu.

## Grove Farm Plantation.

Located upon the Island of Kauai are many plantations which are in successful operation, among which mention is made of the Grove Farm Plantation, owned by G. N. Wilcox and located at Lihue.

The first crop of cane produced upon the lands was in 1884, and was what is known as the Ko-ka, or native variety. This cane was indigenous to the soil and was supposed to have been introduced by the early native inhabitants.

The total area of the plantation is 13,434 acres, divided as follows: Forest, 4495; pasture, 7292; cane, 1397; rice, 250. For the crops of 1902 and 1903 there is approximately 1100 acres, as follows: 1902 crop, 230 acres plant and 305 acres long ratoons; 1903 crop, 165 acres plant and 400 acres long ratoons. Of the total area in cane 285 acres is Yellow Caledonia, the remainder being the Lahaina variety.

The general character of the soil is of a red volcanic nature, carrying oxide of iron, while the greatest elevation that cane is planted is 400 feet. On the mauka lands a test was made of some seventy acres of Yellow Caledonia cane, which yielded 7 1/2 tons of sugar to the acre.

In the plowing of the soil one set of Fowler's steam tackle is in use, the average depth of plowing being fifteen inches, but varying of course according to the soil. Planted cane matures on these lands in about fifteen months, and even after blossoming will continue to ripen and make sugar.

The method of cultivation is hoeing and irrigation, also using Hackfeld's high-grade fertilizers at the rate of 1000 pounds to the acre. Water for irrigation purposes is obtained from Hulula stream, the system of irrigation being entirely by gravity. Several reservoirs have been constructed at various parts of the plantation, having a capacity for thirty-six hours' supply.

The average yield for the whole crop of plant and ratoon canes for a number of years past is six tons of sugar to the acre, or a ton to eight tons of cane.

There is no mill upon the property for the manufacture of sugar, and for years the cane has been ground in the mill of the Lihue plantation on shares, to which point the cane is conveyed by a system of railroads penetrating the various cane fields.

During August of the present year there were employed 185 skilled and unskilled laborers, which is somewhat below the number usually employed. There are a number of work-animals in use upon the plantation, as likewise 500 head of beef cattle and 120 head of sheep.

As stated previously, the product of the plantation is ground in the Lihue mill on percentage of sugar yield. The total share of the sugar realized by the Grove Farm for the season of 1901 was something in excess of 2150 tons.

G. N. Wilcox is the proprietor of this estate, and has resided on Kauai for many years.

## Lihue Plantation Co.

Covering the districts of Lihue and Hanalei on the Island of Kauai are the vast holdings of the Lihue Plantation Company.

The consolidation of the old original Lihue and Hanalei plantations in 1898, gave the present company a total area of 40,460 acres, which is held in fee simple and by long leaseholds.

Of the above area approximately 5600 acres is considered good cane land and, according to last tax returns, the total acreage under cultivation was 4800 acres, some of which is lying fallow.

The first cane planted in this district was fifty-five years ago by W. H. Rice, father of the present W. H. Rice, Sr., and was of the native variety. Later on the Lahaina was brought in by a man by the name of Titcomb and planted extensively.

The wild forest land at high altitudes is all fenced off for the purpose of protecting the forests and the preservation of the water sheds. The character of the soil upon the company's estate is a dark-red loam on the lowlands, carrying in part oxide of iron, while the mauka land is a dark, coarse soil and not of great depth. The elevation that cane is grown runs from practically sea level to 400 feet. In this section all cane tassels and matures in from twelve to fifteen months.

The soil is broken with three sets of Fowler's steam tackle and plows, and by ordinary plows and mules on steep hillsides. The soil on the lowlands is plowed to a depth of from fourteen to sixteen inches.

The system of cultivation is by ordinary hoes; the long ratoons are hilled up by the aid of small rice plows and double mould-boards. Irrigation, as likewise fertilization, is practiced, using about 500 pounds of Hackfeld high-grade fertilizers to the acre. Water supply for irrigation purposes is obtained from Wailua river at an elevation sufficient to cover the entire cane area, the company owning valuable water rights. A part of the cane lands is irrigated direct from the stream, while the lower land is irrigated from reservoirs, of which there are six, with a joint capacity for holding several days' run of water for irrigating purposes.

The average annual rainfall in this district is fifty inches. Sugar yield—Plant cane, to the acre, five and one-half tons;



Water Supply Wailua River, Irrigating Cane Lands on the Lihue Plantation, Island of Kauai

long ratoons, to the acre, four and three-quarters to five tons.

The growing cane which comes off for the 1902 crop is 1050 acres of plant and 21 acres of ratoon canes, while for the 1903 crop there will come off 1032 acres of plant and 1896 acres of ratoons.

The total number of skilled and unskilled labor upon the plantation is 1100, about 80 per cent of which are day laborers, the balance being company men or profit-sharers working under what is known as the co-operative system. The ordinary unskilled or field laborer receives \$20 per month, while the white laborer receives from \$1 a day upwards, both forms of labor receiving in addition to their salary free house room, water, fuel, medical attendance and free care at the company hospital.

Most of the Germans and Portuguese employed are very industrious, and the numerous gulches and small pockets of good land are given over to the more industrious portion of the help, who have established beautiful garden patches where all kinds of vegetables and general garden truck reach the highest state of perfection. Some of these places are from one to three acres in extent, and in many cases a horse and a cow are maintained.

Still another feature of this plantation is a splendid hospital building erected at an expense of \$10,000, and containing separate wards for all nationalities, two separate wards for the better class of people, operating room, dispensary, kitchen fitted up with latest appliances, dining room, nurses' parlor, etc. The building has a veranda in front from ten to twelve feet in width, from whence a splendid view is obtainable.

There are two sugar mills upon the property, one at Lihue and one at Hanalei, which have always been owned and operated by the Lihue Plantation Company, which likewise owns the land leased to individual outside planters, who furnish the mills

with cane and take a certain percentage of the sugar product as compensation.

The Lihue mill is located in Nawiliwili gulch and is a nine-roller Cora mill built by the Fulton Iron Works of St. Louis. The No. 1 mill is 30x60, while Nos. 2 and 3 mills are 34x78. The cane is fed direct to the No. 1 mill from the carrier, the rollers having been grooved about one inch in depth, which takes the place of a crusher. The mill is supplied with juice strainers, Deming system of clarification, 8-foot standard quadruple effect, one 8 and one 16-ton vacuum pans (German patent), twenty 30-inch centrifugals, four of which are driven by water power, as are also the machine shops.

The capacity of the mill is 100 tons in twenty-four hours. Extraction of the sucrose in the cane will average 92 per cent. Clear, hot water is used for maceration.

The company manufactures two grades of sugar, known as A and B. Bagasse is used for fuel, steam being generated by nine boilers, four pair-set tandem and one single multitubular. Two systems of electric lighting have been installed, one for the mill and one for the camp and general headquarters, one dynamo being operated by water power and one by steam.

The Hanalei mill contains four 3-roller mills, No. 1 mill, which is 26x52, acts as a crusher, while the second, third and fourth mills are the 34x78 Cora mills made by the Fulton Iron Works of St. Louis. The mill contains the old system of clarification, cleaning pans, filter presses, three vacuum pans, total capacity thirty-three tons; sixteen centrifugals, electric lighting system, machine shops, etc.

It is the intention of the management to install the carbonation process, using carbonic acid gas for clarifying. The mill has a capacity for turning out eighty tons of sugar in twenty-four hours. This requires operating the mill fifteen hours a day, but working the centrifugals and pans the full twenty-four hours.

At Hanalei there has been erected by the Honolulu Iron Works a pumping system for the purpose of irrigating lands at higher elevations. This plant simply lifts the water from the ditch system to a height of eighty feet.

The company has been operating two large landings, but now have concentrated this method of shipping sugar and receiving freight by the erection of one large landing at Ahukini, Hanalei Bay, including a wharf 150 feet in length by fifty feet in width, whereby the steamers are enabled to come alongside of the wharf and receive sugar direct into the steamer's hold, by means of carrier and chute. This will greatly expedite the handling of sugar; in addition to this, freight will be handled and taken direct from vessels and car by means of steam power.

In order to thoroughly join the two properties it became necessary, due to an enormous intervening gulch, to construct a large trestle 1000 feet in length and sixty-seven feet in height. In order to convey water to the Wailua-kai lands the construction of a tunnel through solid blue rock 374 feet in length and 5x5 in the clear, was found necessary.

The Lihue Plantation Company, believing in the protection and renewal of the forests for preserving the water sheds, planted, twenty years ago, some 600 acres of land lying above the cane fields, and not adapted for cane culture, with a great variety of tree growth, such as ironwood, koa, monkeypod and other native varieties, which now supply the plantation with wood for household use among the camps. The company has maintained for several years a force of twenty men who are engaged exclusively in constantly planting trees in gulches, ravines, etc.

The method of transporting cane to the mills is by rail, there being maintained twenty-eight miles of main trackage and five miles of portable track, the main line being a 39-inch gauge and laid with 21 and 25-pound rails. The rolling stock consists of 420 cane cars having an average capacity for holding two tons of cane; forty sugar cars, capacity four tons; three 14-ton and three 10-ton Baldwin engines.

There is found necessary upon the plantation 190 head of horses and mules. In order to supply the plantation with fresh beef and mutton there are grazing on the lands of the company 1500 head of cattle and 450 head of sheep, while every year from 100 to 150 calves are branded.

From this report it will be readily seen that the operations of the company are quite extensive. The affairs of the plantation are looked after by F. Weber, who has been on the plantation for ten years, and as manager for over a year.

Following are the officers for the fiscal year, October, 1900, to October, 1901:

Paul Isenberg, President.  
C. M. Cooke, Vice President.  
H. A. Isenberg, Treasurer.  
W. C. Parke, Secretary.  
A. S. Wilcox, Auditor.  
Hackfeld & Co., Agents, Honolulu.

## Makee Sugar Co.

Located at Kealia, on the Island of Kauai, are the vast plantation holdings of the Makee Sugar Company, comprising an area of 27,802 acres, 18,337 acres being leasehold and 9465 fee simple. Land adapted for cane is 7141 acres.

At the present time the company has under cultivation 6381 acres. For the 1901 crop there is plant cane 1021 acres, long and short ratoons 1056 acres. The acreage for the 1902 crop consists of 937 acres plant cane, 1192 long ratoons and 104 short ratoons. For the 1903 crop there is plant cane 1205 acres, long ratoons 906 acres, and short ratoons 300 acres.

The cane is entirely of the Lahaina variety, while the general character of the soil is swamp, yellow and red soils, the last-mentioned carrying oxide of iron as a base.

For plowing the soil two 16-horsepower



MILL AND BUILDINGS, MAKEE SUGAR COMPANY, AT KEALIA, ISLAND OF KAUAI

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